Sandia National Laboratories

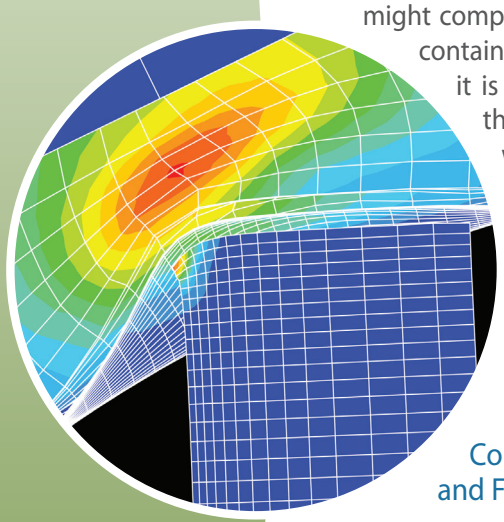
Energy, Climate & Infrastructure Security

Structural Phenomenological Modeling

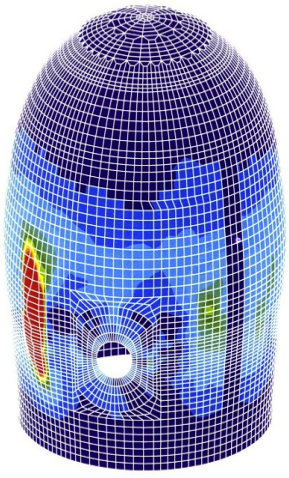
Sandia National Laboratories performs complex systems analysis, structural and mechanical analysis, design, and experiments in support of safety and security assessments of commercial nuclear power generation plants and fuel cycle facilities.

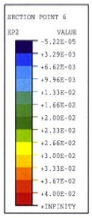
Ensuring the Safe Containment of Hazardous Material

Nuclear safety requires examining a broad range of phenomena. Managing hazardous and radioactive material means ensuring containment of the material even when subjected to high velocity impacts, enormous pressures and stresses, and attacks by saboteurs. In an event that might compromise a structure's successful containment of hazardous material, it is of great importance to know the phenomenology of what would happen and whether a release would result. Sandia is committed to its primary directive of ensuring the safety, security, and reliability of the U.S.'s nuclear technology.



Puncture analysis of a metal spike striking a spent fuel transportation cask





Quarter-scale containment is the largest nuclear reactor containment vessel model ever tested to failure

Comprehensive Array of Tools and Facilities

Sandia's resources enable the completion of a scientific investigation in its entirety. Its engineers are capable of performing a numerical analysis in totality from modeling a structure in software to validating the calculations with experiments and journal data.

Sandia uses the latest engineering software both from industry (i.e. ABACUS) and inside Sandia (i.e. SIERRA and Presto). These codes provide the most sophisticated analyses that can be made for finite element analysis of structures.

Sandia's high performance computing (HPC) platforms include Red Storm, one of the world's most powerful supercomputers, which is used for numerically intensive physics simulations. On-site experimental facilities include The Rocket Sled Track for testing high-velocity impacts, the Drop Tower Facility to observe damage to falling objects and a Centrifuge which can subject items to inertial forces as high as 300 Gs.

Decades of Experience with US Government Agencies and Nuclear Scientists

Sandia engages directly with the most eminent researchers, industrial players, and policymakers in the field of nuclear technology. Adhering to the highest standards of professionalism, Sandia staff interacts directly with the Nuclear Regulatory Commission (NRC) and the Department of Energy. Drawing on nearly 60 years of support provided to the NRC, Sandia applies its extensive knowledge of both regulation-based and extra-regulatory environments to model, test and analyze structures within the area of nuclear energy. The coupling of analytical expertise with the deep knowledge of the regulatory environment produces a comprehensive package uniquely available at Sandia.

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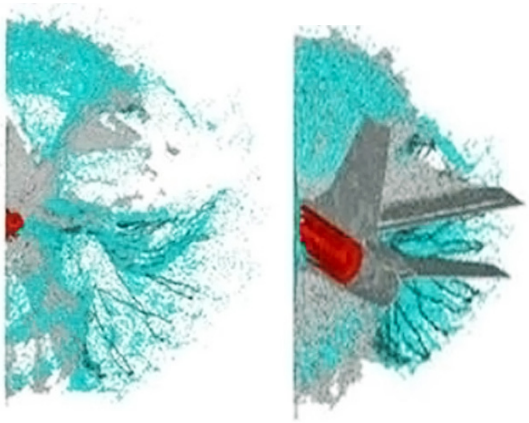
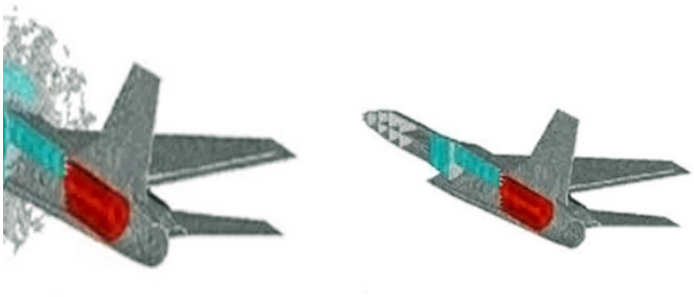
U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND 2012-1670P

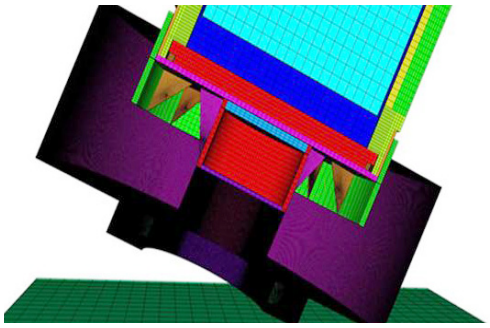




F-16 SPH model (used for private fuel storage aircraft crash analysis for NRC)

Sandia: A Hub of Multidisciplinary Expertise

Sandia draws on more than 60 years of accumulated knowledge in the fields of nuclear power, weapons, and technology. Sandia's staff has extensive experience performing analytical, experimental, and numerical analysis of nuclear physics and the associated engineering. Sandia has researchers representing a wide variety of scientific disciplines including chemistry, physics, mathematics, and computer science. These researchers have published basic research in nuclear physics journals and presented work at premier conferences.



Detail of impact limiter structure

Significant Projects

Sandia has modeled and tested nuclear reactor degradation, an aircraft crashing into a nuclear power plant, and fire in a shipping cask. It also performed the risk assessment for the National Aeronautical Space Administration's launch of the nuclear battery-powered Mars Science Lab Rover. Sandia tries to anticipate and provide solutions for every possible accident scenario involving the dispersion of nuclear material in every phase of the fuel cycle from its use in a power plant to transportation and storage.

Publications

Harding, D. C. (2012). ENSA certification analyses for certification analysis report of a new rail cask for equipos nucleares, SA (ENSA) (SAND2012-1556-P). Albuquerque, NM: Sandia National Laboratories.

Petti, J. P., & Kalan, R. J. (2011). LNG cascading damage study, Vol. I, fracture testing report (SAND2011-3342). Albuquerque, NM: Sandia National Laboratories.

(2010). PAT-1 safety analysis report addendum. Certification analyses for new contents in the PAT-1 Package (SAND2010-6109). Albuquerque, NM: Sandia National Laboratories.

Petti, J. P., Naus, D. J., Sagues, A., Weyers, R. E., Erler, B. A., … & Berke, N. S. (2010). Nuclear containment steel liner corrosion workshop: Final summary and recommendation report (SAND2010-8718). Albuquerque, NM: Sandia National Laboratories.

Harding, D. C., Akin, L. A., Yoshimura, R. H., & Miller, D. R. (2010, October). A stress-state modified strain based failure criterion for evaluating the structural integrity of an inner eutectic barrier. Conference paper at 2010 Packaging and Transportation of Radioactive Materials Conference, London, United Kingdom.

Caviness, M., Rubin, J., Mason, R., Wilson, S., Yoshimura, R., Akin, L., Harding, D. C., & Mann, P. (2010, July). Air transport of plutonium metal: Content expansion initiative for the Plutonium Air Transportable (PAT-1) packaging. Conference paper at 2010 International Nuclear Materials Management Conference, Baltimore, MD.

Lopez, C., & Petti, J. P. (2008). Finite element analysis of the Arquin-designed CMU wall under a dynamic (blast) load (SAND2008-8123). Albuquerque, NM: Sandia National Laboratories.

Petti, J. P. (2007). Structural integrity analysis of the degraded drywell containment at the Oyster Creek Nuclear generating station (SAND2007-0055). Albuquerque, NM: Sandia National Laboratories.

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